

*The*  
PHYSIOLOGICAL BASIS  
*of*  
MEDICAL PRACTICE

A UNIVERSITY OF TORONTO  
TEXT IN APPLIED PHYSIOLOGY

*By*

CHARLES HERBERT BEST

C.B.E., M.A., M.D., D.Sc. (Lond.), F.R.S., F.R.C.P. (Canada)

*Professor and Head of Department of Physiology,  
Director of the Banting-Best Department of  
Medical Research, University of Toronto*

*and*

NORMAN BURKE TAYLOR

V.D., M.D., F.R.S. (Canada), F.R.C.S. (Edin.), F.R.C.P. (Canada),  
M.R.C.S. (Eng.), L.R.C.P. (Lond.)

*Professor of Physiology, University of Toronto*



*Fourth Edition*

THE WILLIAMS & WILKINS COMPANY  
BALTIMORE

1945

# CONTENTS

## SECTION I. THE BLOOD AND LYMPH

### CHAPTER I

THE PHYSIOLOGICAL PROPERTIES, PHYSICAL CHARACTERS AND COMPOSITION OF BLOOD.....	1
---	---

### CHAPTER II

THE RED CELLS OR ERYTHROCYTES.....	7
------------------------------------	---

### CHAPTER III

THE BLOOD VOLUME. WATER BALANCE. HEMORRHAGE.....	14
--	----

### CHAPTER IV

THE LYMPH AND TISSUE FLUIDS.....	27
----------------------------------	----

### CHAPTER V

TRANSFUSION. BLOOD GROUPS.....	33
--------------------------------	----

### CHAPTER VI

HEMOGLOBIN.....	40
-----------------	----

### CHAPTER VII

HEMOLYSIS AND SUSPENSION STABILITY OF THE BLOOD.....	48
--	----

### CHAPTER VIII

THE SPLEEN; THE LIFE OF THE RED CELL; THE REGENERATION OF BLOOD.....	53
--	----

### CHAPTER IX

THE ANEMIAS.....	61
------------------	----

### CHAPTER X

THE WHITE BLOOD CORPUSCLES OR LEUCOCYTES. THE PLATELETS.....	70
--	----

### CHAPTER XI

THE ORIGIN OF THE BLOOD CELLS.....	77
------------------------------------	----

### CHAPTER XII

THE COAGULATION OF BLOOD.....	88
-------------------------------	----

### CHAPTER XIII

THE MECHANISMS REGULATING THE REACTION OF THE BODY FLUIDS.....	99
--	----

## SECTION II. THE CIRCULATION OF THE BLOOD

### CHAPTER XIV

THE DYNAMICS OF THE CIRCULATION.....	112
--------------------------------------	-----

### CHAPTER XV

THE ARTERIAL BLOOD PRESSURE.....	120
----------------------------------	-----

### CHAPTER XVI

THE BLOOD PRESSURE IN THE HUMAN SUBJECT.....	125
--	-----

### CHAPTER XVII

THE VELOCITY OF THE BLOOD.....	145
--------------------------------	-----

### CHAPTER XVIII

THE ARTERIAL PULSE.....	150
-------------------------	-----

CHAPTER XIX	
THE PHYSIOLOGY OF CARDIAC MUSCLE.....	154
CHAPTER XX	
THE ORIGIN AND MODE OF TRANSMISSION OF THE HEART BEAT.....	161
CHAPTER XXI	
THE CARDIAC CYCLE.....	168
CHAPTER XXII	
THE MOVEMENTS OF THE HEART VALVES. THE HEART SOUNDS.....	175
CHAPTER XXIII	
ELECTROCARDIOGRAPHY. THE VENOUS PULSE.....	180
CHAPTER XXIV	
DISORDERS OF THE HEART BEAT AND THEIR INVESTIGATION BY GRAPHIC METHODS....	190
CHAPTER XXV	
THE REGULATION OF THE HEART'S ACTION.....	205
CHAPTER XXVI	
THE OUTPUT OF THE HEART.....	224
CHAPTER XXVII	
THE CONTROL OF THE BLOOD VESSELS. THE VASOMOTOR MECHANISMS. PERIPHERAL VASCULAR DISORDERS. SURGICAL SHOCK.....	232
CHAPTER XXVIII	
SPECIAL FEATURES OF THE CIRCULATION IN DIFFERENT REGIONS.....	264
SECTION III. RESPIRATION	
CHAPTER XXIX	
THE MECHANICS OF RESPIRATION.....	293
CHAPTER XXX	
THE AIR OF THE LUNGS.....	308
CHAPTER XXXI	
THE PHYSICAL PRINCIPLES GOVERNING THE RESPIRATORY EXCHANGES.....	313
CHAPTER XXXII	
THE TRANSPORT AND DELIVERY OF OXYGEN TO THE TISSUES.....	319
CHAPTER XXXIII	
THE CARRIAGE OF CARBON DIOXIDE BY THE BLOOD.....	337
CHAPTER XXXIV	
THE CONTROL OF RESPIRATION.....	342
CHAPTER XXXV	
ANOXIA.....	358
SECTION IV. THE EXCRETION OF URINE	
CHAPTER XXXVI	
URINE FORMATION, THE STRUCTURE OF THE KIDNEY; THEORIES OF RENAL FUNCTION; VOLUME AND COMPOSITION OF THE URINE.....	377

## CHAPTER XXXVII

THE PATHOLOGICAL PHYSIOLOGY OF KIDNEY DISEASE. MICTURITION.....	399
---	-----

SECTION V. DIGESTION

## CHAPTER XXXVIII

THE SALIVARY GLANDS AND THE SECRETION OF SALIVA.....	416
--	-----

## CHAPTER XXXIX

GASTRIC DIGESTION.....	423
------------------------	-----

## CHAPTER XL

GASTRIC DIGESTION (CONTINUED). THE SECRETION OF GASTRIC JUICE.....	430
--	-----

## CHAPTER XLI

DIGESTION IN THE INTESTINE.....	449
---------------------------------	-----

## CHAPTER XLII

THE GALL-BLADDER AND BILE DUCTS.....	471
--------------------------------------	-----

## CHAPTER XLIII

THE MOVEMENTS OF THE ALIMENTARY CANAL.....	477
--	-----

## CHAPTER XLIV

MOVEMENTS OF THE ALIMENTARY CANAL (CONTINUED). ABSORPTION FROM THE INTESTINES; THE FORMATION OF FECES; CONSTIPATION; INTESTINAL OBSTRUCTION.....	496
--	-----

## CHAPTER XLV

VISCERAL SENSATIONS.....	514
--------------------------	-----

SECTION VI. METABOLISM AND NUTRITION

## CHAPTER XLVI

GENERAL METABOLISM.....	522
-------------------------	-----

## CHAPTER XLVII

PROTEIN METABOLISM.....	538
-------------------------	-----

## CHAPTER XLVIII

PROTEIN METABOLISM (CONTINUED).....	557
-------------------------------------	-----

## CHAPTER XLIX

THE METABOLISM OF THE PURINE AND PYRIMIDINE BASES.....	564
--	-----

## CHAPTER L

CARBOHYDRATE METABOLISM.....	569
------------------------------	-----

## CHAPTER LI

FAT METABOLISM.....	593
---------------------	-----

## CHAPTER LII

THE METABOLISM IN STARVATION (FASTING), OBESITY AND UNDERNUTRITION.....	607
---	-----

## CHAPTER LIII

METABOLISM IN MUSCULAR ACTIVITY.....	612
--------------------------------------	-----

## CHAPTER LIV

THE BODY TEMPERATURE. HEAT BALANCE.....	623
---	-----

	CHAPTER LV	
THE VITAMINS.....		635
	CHAPTER LVI	
THE VITAMINS (CONTINUED).....		649
	CHAPTER LVII	
DIETARY REQUIREMENTS.....		663
SECTION VII. THE DUCTLESS GLANDS OR ENDOCRINES		
	CHAPTER LVIII	
INTRODUCTION. THE THYROID GLAND.....		670
	CHAPTER LIX	
THE ADRENAL GLANDS (SUPRARENAL CAPSULES).....		684
	CHAPTER LX	
THE PARATHYROID GLANDS AND CALCIUM METABOLISM.....		700
	CHAPTER LXI	
THE PITUITARY GLAND (HYPOPHYSIS CEREBRI). ANTIHORMONES.....		722
	CHAPTER LXII	
THE ENDOCRINE ORGANS OF SEX. THE THYMUS AND PINEAL GLANDS.....		743
SECTION VIII. THE NERVOUS SYSTEM		
	CHAPTER LXIII	
INTRODUCTORY. THE PHYSIOLOGICAL PROPERTIES OF NERVE.....		776
	CHAPTER LXIV	
THE REFLEX ARC. RECEPTOR ORGANS. CUTANEOUS AND KINESTHETIC SENSATIONS.....		797
	CHAPTER LXV	
REFLEX ACTION.....		810
	CHAPTER LXVI	
THE PHYSIOLOGICAL MECHANISMS GOVERNING POSTURE AND EQUILIBRIUM.....		822
	CHAPTER LXVII	
THE SPINAL CORD AND BRAIN STEM (MEDULLA, PONS AND MID-BRAIN).....		847
	CHAPTER LXVIII	
THE EXTRAPYRAMIDAL SYSTEM. THE THALAMUS AND HYPOTHALAMUS.....		874
	CHAPTER LXIX	
THE CEREBRAL CORTEX. THE PHYSIOLOGY OF SPEECH AND SOME OF ITS DISORDERS. APRAXIA AND AGNOSIA. EPILEPSY. HEADACHE. ELECTRO-ENCEPHALOGRAM.		886
	CHAPTER LXX	
CONDITIONED REFLEXES. SLEEP.....		907
	CHAPTER LXXI	
THE CEREBELLUM.....		921
	CHAPTER LXXII	
THE CEREBROSPINAL FLUID.....		932

## CHAPTER LXXIII

THE AUTONOMIC NERVOUS SYSTEM.....	936
-----------------------------------	-----

## SECTION IX. THE SPECIAL SENSES

## CHAPTER LXXIV

THE PHYSIOLOGY OF VISION. STRUCTURE OF THE EYEBALL. DUPLICITY THEORY. REACTIONS OF THE RETINA; SUBJECTIVE PHENOMENA.....	952
---	-----

## CHAPTER LXXV

THE NATURE OF THE RETINAL PROCESS; OBJECTIVE RETINAL PHENOMENA; COLOR VISION.....	970
--	-----

## CHAPTER LXXVI

THE DIOPTRIC MECHANISMS OF THE EYE. CATARACT. OPTICAL DEFECTS. IN- TRAOCULAR FLUIDS.....	983
---	-----

## CHAPTER LXXVII

THE VISUAL FIELDS AND PATHWAY. THE PUPIL. MOVEMENTS OF THE OCULAR MUSCLES. STEREOSCOPIC VISION.....	1006
--	------

## CHAPTER LXXVIII

THE EAR. ANATOMICAL OUTLINE. SOUND, GENERAL PRINCIPLES.....	1020
---	------

## CHAPTER LXXIX

AUDITORY SENSATIONS. THE MECHANISM OF HEARING. THE TELEPHONE AND RESONANCE THEORIES.....	1030
---	------

## CHAPTER LXXX

THE EUSTACHIAN TUBE. DEAFNESS. HEARING TESTS. THE HARMFUL EFFECTS OF NOISE.....	1044
--	------

## CHAPTER LXXXI

THE CHEMICAL SENSES.....	1048
--------------------------	------

REFERENCES.....	1059
-----------------	------

INDEX.....	1117
------------	------